

enormous ranges repeat themselves day after day, owing to the persistent bright sunshine. The sunshine recorder reveals the fact that there are about 4,000 hours of sunshine per year, which is about 92 per cent of the possible sunshine. Only seldom do short, heavy showers occur which effect a cooling of the stony surface. These showers, while brief, are of great importance, both from their chemical action upon the rocks and from their ability to transport, in a very short time, great masses of accumulated deposit.—C. L. M.

551.524

#### DAILY COURSE OF TEMPERATURE IN THE LOWER AIR.<sup>1</sup>

By WILHELM SCHMIDT.

"All observations, both those in the free air and those on towers near the ground, agree fully with the theory that two reasons for the occurrence of the daily temperature course are:

"1. Radiation on the earth's surface, which through conduction of heat from sunlight sends up a rapidly decreasing temperature wave into the air, which on the average is noticeable up to about 500 to 1,000 meters, and

"2. Direct radiation conversion in the air, which throughout the whole atmosphere produces a temperature variation of essentially the same phase.

"\* \* \* The same causes, although different in characteristics of strength, occur naturally also in the annual course. One could evaluate even these, but he has no more the pure simple characteristics, since the conditions aloft do not locally depend on the underlying conditions, but through convection are changed from afar and made uniform." <sup>2</sup>

#### DISCUSSION.<sup>3</sup>

"At the meeting, on January 24, Mr. L. F. Richardson discussed papers by W. Schmidt on (1) exchange of mass in irregular currents in the free air and its consequences, and (2) the effects of the exchange of air on climate and the diurnal variation of temperature in the upper air.

"The central idea of Schmidt's papers is that the same laws will govern the exchange of various properties between layers of the atmosphere. Heat, water vapor, dust, and carbonic acid can all be transported, and in each case the result of mixing two samples of air from different regions is that the concentration of the property in question is averaged. The rate at which this averaging takes place is measured by a certain coefficient  $A$ , the 'Austausch,' which is defined by the author in a somewhat complicated way. In the kinetic theory of a gas regarded as an aggregate of molecules the 'Austausch' would be proportional to the frequency with which molecules cross unit area on a horizontal plane and to their mean free path. In the theory of eddies there is nothing which corresponds exactly with the mean free path, and the specification of the 'Austausch' leads to difficulties. The 'Austausch' is closely related to the coefficient  $\epsilon$  of Mr. Richardson's own papers on this subject, and it is equal to  $k\rho$ , where  $k$  is the coefficient denoted by that symbol in G. I. Taylor's work and  $\rho$  is the density.

"As an example of Schmidt's results we may quote his estimates of the rate at which water passes upward in the form of vapor past the levels of 1,000 m. and 3,000 m. For Lindenberg he finds that in the course of the average day 0.063 gram of water is carried upward across each square centimeter at 1,000 m. and similarly 0.039 at 3,000 m. These values are arrived at by estimating the 'Austausch' from considerations of wind strength, and applying the result to find the movement of the water vapor.

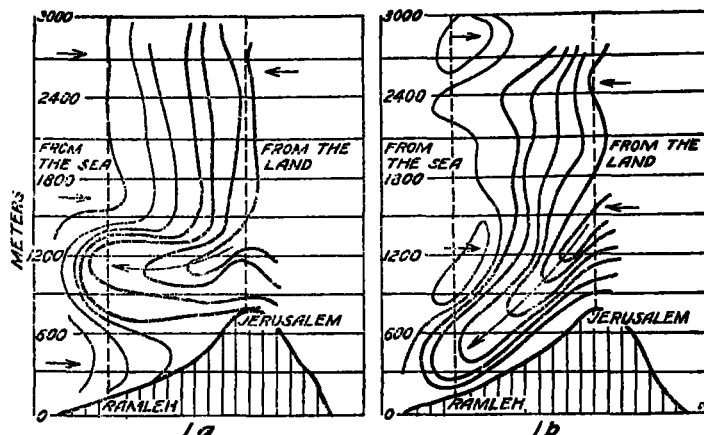
"The great range in the possible values of the 'Austausch,' which is practically a measure of turbulence, is remarkable. Using wind observations, Schmidt finds that the average 'Austausch' at 200 meters is nearly 30 times that at 1 meter."

#### THE SIROCCOS OF THE SINAI DESERT.

551.55 (569.4) By W. SPÄTH.

[Abstracted from *Meteorologische Zeitschrift*, Jan.-Feb., 1920, pp. 26-29.]

This article on the siroccos of Palestine does not add much to the material presented in earlier paper by Walter Georgii in *Meteorologische Zeitschrift*.<sup>1</sup> Of chief



FIGS. 1a-1b.—Wind conditions above Jerusalem and Ramleh, on March 29 and 30, 1917, respectively, showing the advance of the tongue of hot, dry air over the mountains and down the slope toward the sea.

interest are the diagrams. The author has shown the advance of the wind over the mountains of Judea by means of vertical sections normal to the wind direction. The hot wind is from the southeast. This enabled the synchronous conditions at Jerusalem and Ramleh to be portrayed. The first of two diagrams showing the sirocco of March 29-30, 1917, shows an advancing tongue of southeast wind passing over the range and extending in a northwesterly direction over Jerusalem. This wind is being opposed by a wind from the sea. The second figure shows the tongue of warm, dry air, descending along the slope and consequently heating dynamically. The cool on-shore wind is still contesting the advance of the southeast wind aloft. (Figs. 1a-1b.)

Another interesting diagram (Fig. 2a), is that showing the conditions at Ramleh from March 21 to 30, 1917. The abscissae are days, the ordinates are altitudes, and the curves are lines of equal wind intensity. The sirocco wind is shown in heavy lines and the sea wind is in light lines. The last diagram (Fig. 2b), also show-

<sup>1</sup> Über den täglichen Temperaturgang in den unteren Luftschichten. *Meteorologische Zeitschrift*, 1920, H. 3/4. Bd. 37:49-59. 2 figs.

<sup>2</sup> Extracts from author's summary.

<sup>3</sup> Reprinted from the *Meteorological Magazine*, London, Feb., 1921, pp. 7-8.

<sup>1</sup> Sirocco observations in the southwestern part of Palestine. 36:193-197, 1919. Abstract in *MO. WEATHER REV.* Jan. 1920, p. 40.

ing conditions at Ramleh over the same period differs from the previous one in that the ordinates represent the hours of the day. Here, also winds of equal inten-

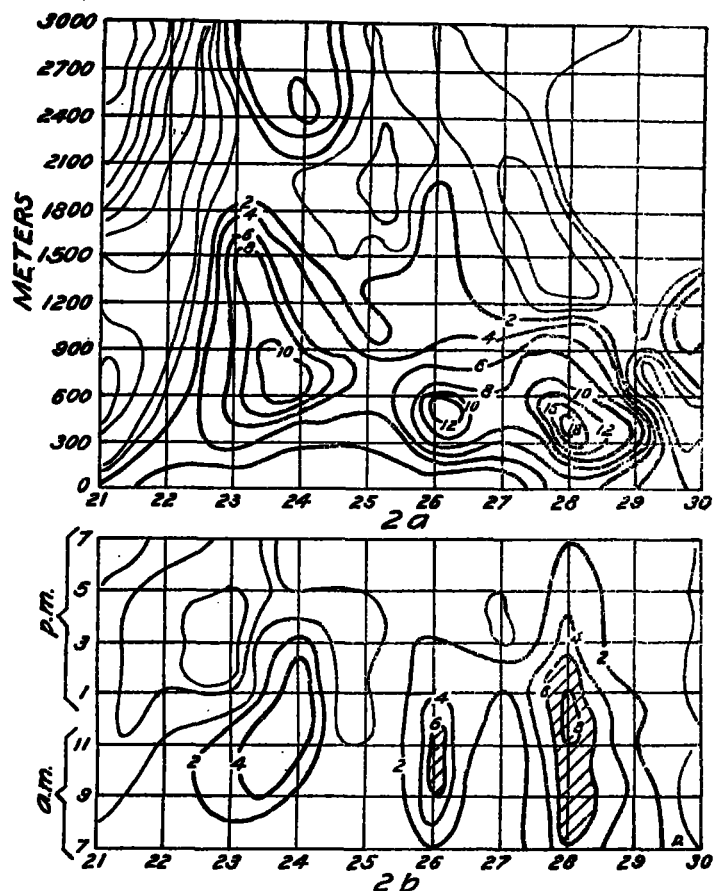


FIG. 2a.—Lines of equal wind strength above Ramleh, March 21-30, 1917; heavy lines being sirocco wind, light lines, sea wind.

FIG. 2b.—Lines of equal surface wind strength at Ramleh, March 21-30, 1917; heavy lines being sirocco wind, light lines, sea wind.

sity are joined by curves. Winds of over 6 meters per second are sufficient to carry with them clouds of dust and these dust storms are shown by hachure.—C. L. M.

#### THE COOL BREEZE OF THE SHADOW OF THE CUMULUS.<sup>1</sup>

By W. J. HUMPHREYS.

[Weather Bureau, Washington, D. C., Apr. 21, 1921.]

In respect to many things it may be sanely philosophical to "take the good the gods provide thee" and ask

<sup>1</sup> Presented before the American Meteorological Society at Washington, Apr. 21, 1921.

#### BIBLIOGRAPHIC NOTES ON THE TEMPERATURE CHARTS OF THE UNITED STATES.

551.524 (084.3) (73)

By ROBERT DE C. WARD.

[Harvard University, Cambridge, Mass., June 8, 1921.]

In connection with a general study of the climatology of the United States upon which the writer has for some years been engaged, brief references have from time to time been made on the various available isothermal charts of this country. The publication of the following notes on these charts may be of interest to others for two reasons. First, because of the completion, for the section on climate of the new *Atlas of American Agriculture*, of a

no questions, but in meteorology, at least, such *sans souci* is unscientific, however great our gratitude. And so it happens that when, on a sweltering day, the passing cumulus, for instance, brings its grateful breeze we ask whence it came and how. Well, the answer is not entirely simple, not all in just a word or two, but still clear enough to give something of that mental satisfaction that comes with every conscious understanding. Essentially it is as follows:

During calm, clear summer days, the surface of the earth, especially in more or less arid regions, becomes strongly heated by the sunshine. This heated surface in turn correspondingly warms the adjacent air and thereby establishes a proportionately vigorous vertical convection in the lower atmosphere. Convection, however, can not extend through the heated surface, hence the very lowest air is rather stagnant and superheated. Indeed, while the amount of convective mixing rapidly increases with elevation, nevertheless it often is still imperfect at a level of even several hundred feet. Throughout all that region, however, in which convection is perfect a slightly warmed mass of air would continue to rise, and a cooled mass continue to fall, being at each level a little warmer or a little cooler, respectively, than the then adjacent atmosphere of the same level.

Now, obviously, free air (air at an appreciable altitude above the surface) in the sunshine usually is a trifle warmer than is the neighboring air at the same level within the shade of a cumulus. Hence, in general, the former is ascending and the latter descending, except just under the forward base of the cloud—a mere detail that need not here be further considered. Clearly, too, the descending air must spread out near the surface—spread out because it can not blow into the ground—and it is this spreading out of the descending air that constitutes the gentle breeze that so frequently accompanies the shadow of the cumulus cloud.

The refreshing drop in temperature that also accompanies the shadow of the cumulus is yet to be explained.

Since the air is heated mainly by the surface of the earth which itself was warmed by the absorption of solar radiation, and since the very lowest air is not vigorously mixed by convection, it follows that during a calm summer day, sand and barren soil, the adjacent air, and even one's outer clothing, all become quite hot when exposed to the sunshine—often 10 degrees or more hotter than the free air 50 to 100 feet above. Within a few minutes, however, after a heavy shadow comes on nearly all this excess of temperature has disappeared—lost by radiation, convection, and conduction. Hence the breeze due to the descending air within the cumulus shadow, explained above, is really cool, in comparison to the superheated surface air out in the sunshine; it is, in truth, the well-known and ever-grateful cool breeze of the shadow of the cumulus.

wholly new set of temperature maps,<sup>1</sup> and, secondly, because no list of the earlier charts seems heretofore to have been printed. The following bibliography contains reference to all the charts to which the writer has, up to the present time, been able to gain access. There may be, and doubtless are, omissions.<sup>2</sup> It is not the purpose of

<sup>1</sup> Not yet published.

<sup>2</sup> Readers of the REVIEW will confer a favor on the writer by notifying him of any such.